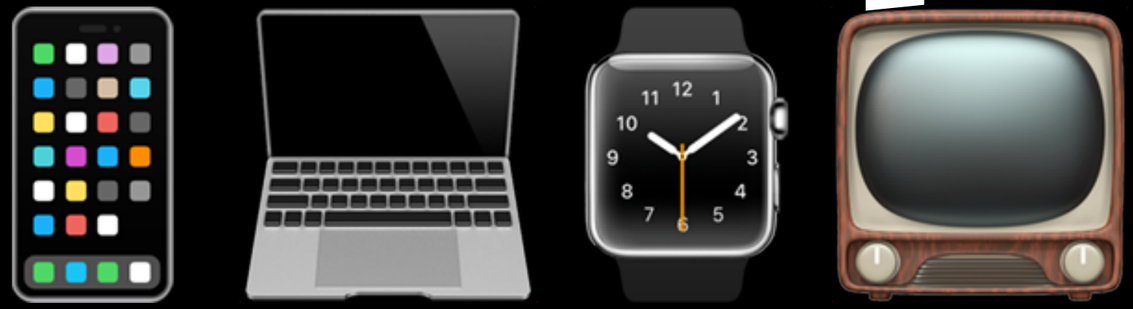
Making your own tool using SwiftSyntax


Hi, I'm Yusuke
@kitasuke

App development



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Source code

Making your own tool using SwiftSyntax, Yusuke Kita (@kitasuke)

Tools 

Making your own tool using SwiftSyntax, Yusuke Kita (@kitasuke)

Tools help make programming easier

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Tools using SwiftSyntax

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SwiftUI Previews

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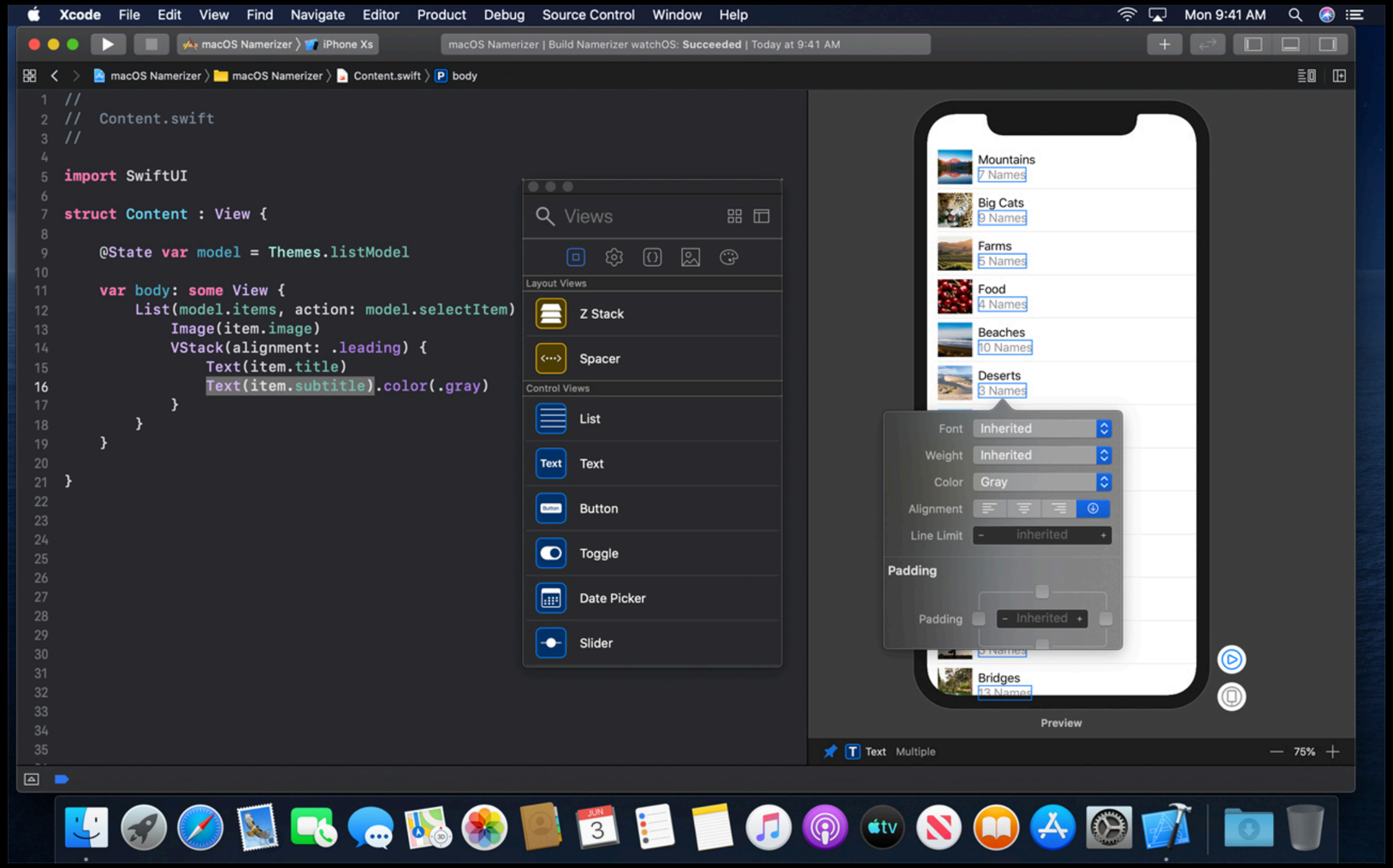
SwiftUI Previews



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swift-format

SE-0250: Swift Code Style Guidelines and Formatter

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swift-format

✅

```
let number: Int = 5
```

⛔

```
let number:Int = 5
let number : Int = 5
```

SwiftConst

Find in repeated strings that could be replaced by a constant

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SwiftConst

```
$ swiftconst run
other occurrence(s) of "error" found in: main.swift:7:11
other occurrence(s) of "help" found in: main.swift:18:19
other occurrence(s) of "error" found in: main.swift:19:28
other occurrence(s) of "help" found in: main.swift:21:19
```

SwiftSyntax

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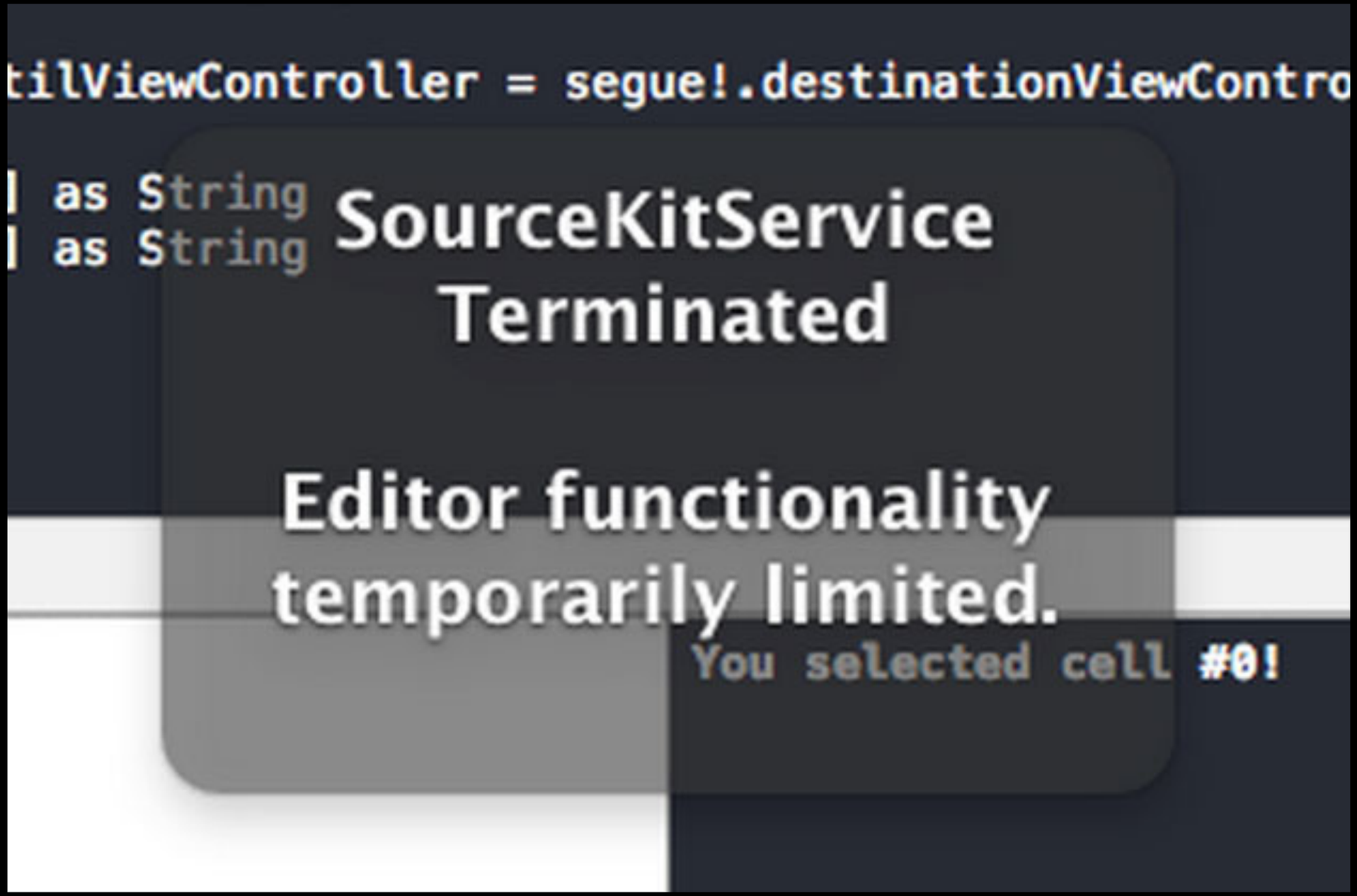
tilViewController = segue!.destinationViewContro
] as String
] as String
SourceKitService
Terminated
Editor functionality
temporarily limited.
You selected cell #0!

What's SwiftSyntax for?

Code modifier

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Code analyzer

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What's SwiftSyntax?

SwiftSyntax is a set of Swift bindings for the libSyntax library. It allows for Swift tools to parse, inspect, generate, and transform Swift source code.

libSyntax

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libSyntax library aims to represent the syntax tree of the source file

Syntax Tree

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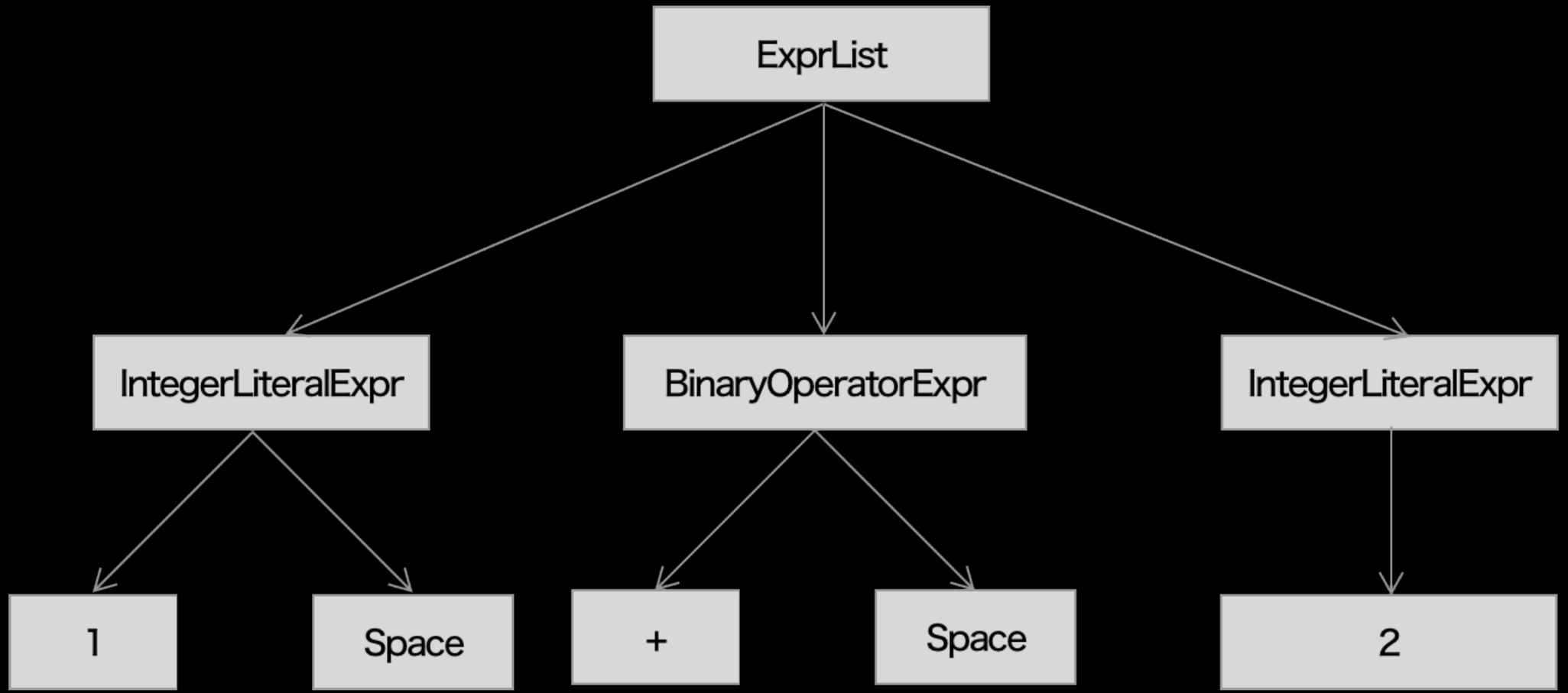
1 + 2


ExprList
IntegerLiteralExpr
BinaryOperatorExpr
IntegerLiteralExpr
1
Space
+
Space
2

SwiftSyntax parses Swift source code to syntax tree

How to emit syntax tree

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```
$ swift -frontend emit-syntax
```

Parse input file(s) and emit the Syntax tree(s) as JSON

$ swift -frontend emit-syntax

```
// 1 + 2
- SourceFile
    - CodeBlockItemList
        - CodeBlockItem
            - SequenceExpr
                - ExprList
                    - IntegerLiteralExpr
                        - integer_literal: 1
                        - trailingTrivia: Space
                    - BinaryOperatorExpr
                        - oper_binary_spaced: +
                        - trailingTrivia: Space
                    - IntegerLiteralExpr
                        - integer_literal: 2
```

Swift AST Explorer

Swift AST to HTML conversion

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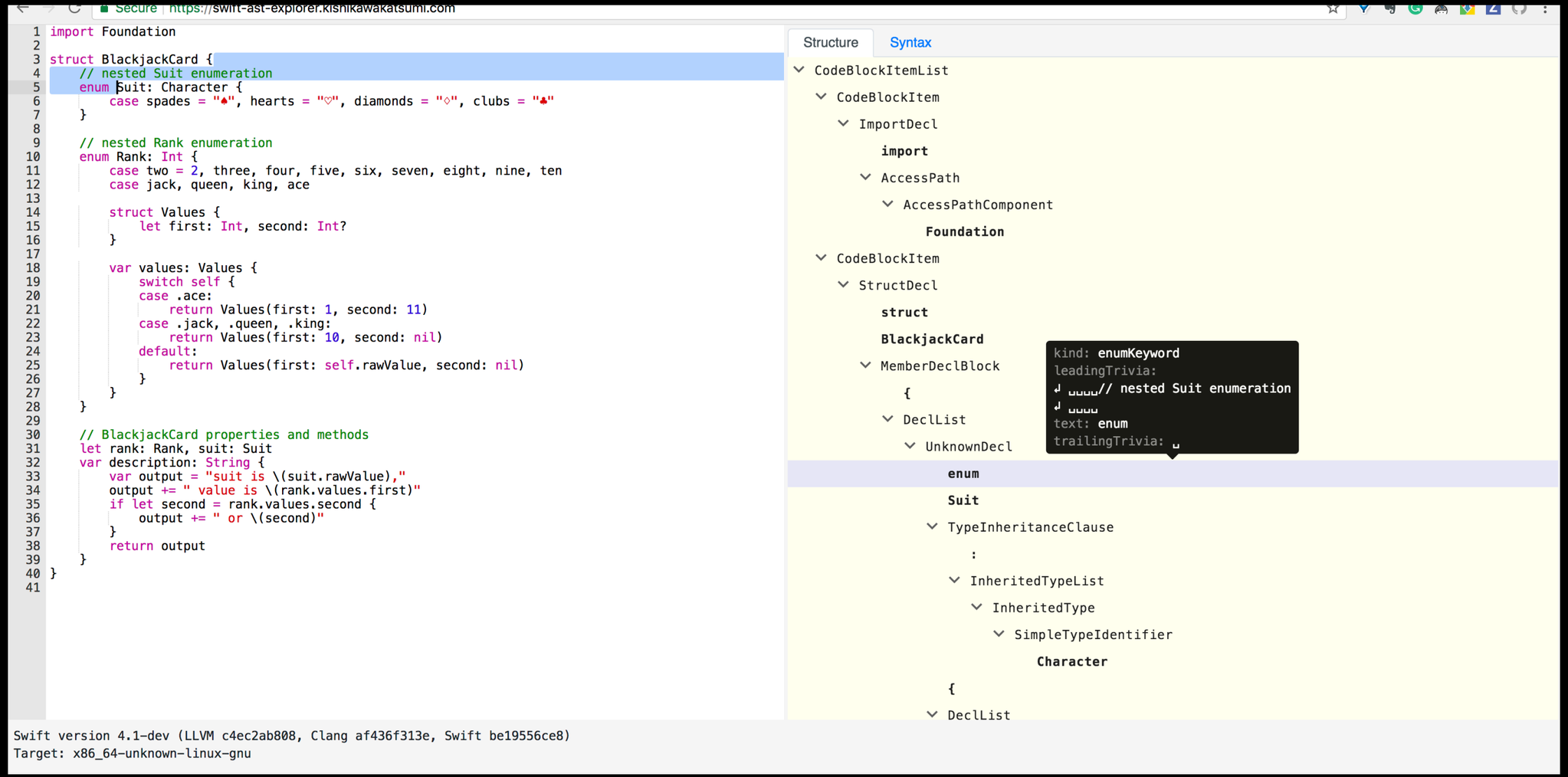
Swift AST Explorer



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Recap

Recap

→ SwiftSyntax is a parsing tool

Recap

→ SwiftSyntax is a parsing tool

→ Emits syntax tree

Recap

→ SwiftSyntax is a parsing tool

→ Emits syntax tree

→ Allows to inspect and transform source code

How SwiftSyntax works?

Usage via SwiftPM

Package.swift

```
import PackageDescription

let package = Package(
  name: "MyTool",
  dependencies: [
    .package(url: "https://github.com/apple/swift-syntax.git",
      .exact("<#Specify Release tag#>")),
  ],
  targets: [
    .target(name: "MyTool", dependencies: ["SwiftSyntax"]),
  ]
)
```

Interfaces

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SyntaxParser

Parsing Swift source

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SyntaxParser

```
/// Parses the file `URL` into a full-fidelity Syntax tree.
///
/// - Parameters:
///   - url: The file URL to parse.
///   - diagnosticEngine: Optional diagnostic engine to where the parser will
///       emit diagnostics
/// - Returns: A top-level Syntax node representing the contents of the tree,
///            if the parse was successful.
/// - Throws: `ParserError`
public static func parse(_ url: URL,
    diagnosticEngine: DiagnosticEngine? = nil) throws -> SourceFileSyntax
```

SourceFileSyntax

Structure of source file

SourceFileSyntax

```
// 1 + 2 in sample.swift
- SourceFileSyntax
    - CodeBlockItemListSyntax
        - CodeBlockItemSyntax
            - SequenceExprSyntax
                - ExprListSyntax
                    - IntegerLiteralExprSyntax
                        - integerLiteral: 1
                        - trailingTrivia: Space
                    - BinaryOperatorExprSyntax
                        - spacedBinaryOperator: +
                        - trailingTrivia: Space
                    - IntegerLiteralExprSyntax
                        - integerLiteral: 2
```

Syntax

IntegerLiteralExprSyntax

```
public struct IntegerLiteralExprSyntax:
  ExprSyntax, _SyntaxBase, Hashable {
  enum Cursor: Int {
    case digits
  }

  public var digits: TokenSyntax {...}
  ...
}
```

TokenSyntax

```
/// A Syntax node representing a single token.
public struct TokenSyntax: _SyntaxBase, Hashable {
  /// The text of the token as written in the source code.
  public var text: String {
    return tokenKind.text
  }
  ...
}
```

Syntaxes

`IdentifierExprSyntax`, `ArrayExprSyntax`,

`DictionaryExprSyntax`, `IntegerLiteralExprSyntax`,

`BooleanLiteralExprSyntax`, `FunctionCallExprSyntax`,

`StringLiteralExprSyntax`, `ClassDeclSyntax`, `StructDeclSyntax`,

`ProtocolDeclSyntax`, `VariableDeclSyntax`, `EnumDeclSyntax`,

`SwitchStmtSyntax`, `IfStmtSyntax` ...

SyntaxVisitor

Visiting each syntax

SyntaxVisitor

```
/// Visiting `IntegerLiteralExprSyntax` specifically.
///   - Parameter node: the node we are visiting.
///   - Returns: how should we continue visiting.
mutating func visit(_ node: IntegerLiteralExprSyntax) -> SyntaxVisitorContinueKind {
  return .visitChildren
}

/// The function called after visiting `IntegerLiteralExprSyntax` and its descendents.
///   - node: the node we just finished visiting.
mutating func visitPost(_ node: IntegerLiteralExprSyntax) {}
```

SyntaxRewriter

Rewriting each syntax

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SyntaxRewriter

```
open func visit(_ node: IntegerLiteralExprSyntax) -> ExprSyntax {
  return visitChildren(node) as! ExprSyntax
}
```

SyntaxFactory

Make each syntax

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SyntaxFactory

```
public static func makeIntegerLiteralExpr(digits: TokenSyntax)
  -> IntegerLiteralExprSyntax {
  let layout: [RawSyntax?] = [
    digits.raw,
  ]
  let raw = RawSyntax.createAndCalcLength(
    kind: .integerLiteralExpr,
    layout: layout,
    presence: .present
  )
  let data = SyntaxData.forRoot(raw)
  return IntegerLiteralExprSyntax(data)
}
```

Usecases

Odd number inspector 

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Odd number inspector

```
// Use even instead, not odd
view.frame.height = 43
```

OddNumberInspector

```
struct OddNumberInspector: SyntaxVisitor {
    mutating func visitPost(_ node: IntegerLiteralExprSyntax) {
        // do nothing if it's even
        guard let integer = Int(node.digits.text),
            integer % 2 == 1 else {
            return
        }
        print("Use even instead, not odd")
    }
}
```

OddNumberInspector

```
struct OddNumberInspector: SyntaxVisitor {
    mutating func visitPost(_ node: IntegerLiteralExprSyntax) {
        // do nothing if it's even
        guard let integer = Int(node.digits.text),
            integer % 2 == 1 else {
            return
        }
        print("Use even instead, not odd")
    }
}
```

OddNumberInspector

```
struct OddNumberInspector: SyntaxVisitor {
    mutating func visitPost(_ node: IntegerLiteralExprSyntax) {
        // do nothing if it's even
        guard let integer = Int(node.digits.text),
            integer % 2 == 1 else {
            return
        }
        print("Use even instead, not odd")
    }
}
```

main.swift

```
// parse Swift source to get SourceFileSyntax
let sourceFile = try SyntaxParser.parse(pathURL)

// walk SourceFileSyntax with visitor
var visitor = OddNumberInspector()
sourceFile.walk(&visitor)
```

main.swift

```
// parse Swift source to get SourceFileSyntax
let sourceFile = try SyntaxParser.parse(pathURL)

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var visitor = OddNumberInspector()
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```

Odd number inspector

```
// Use even instead, not odd
view.frame.height = 43
```

Ten multiplication formatter 💪

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Ten multiplication formatter

```
let i: Int = 1 // -> 10
```

TenMultiplicationFormatter

```
class TenMultiplicationFormatter: SyntaxRewriter {
    override func visit(_ node: IntegerLiteralExprSyntax) -> ExprSyntax {
        guard let integer = Int(node.digits.text) else {
            return node
        }

        let digits = SyntaxFactory.makeIntegerLiteral(
            String(integer * 10),
            leadingTrivia: node.leadingTrivia ?? .zero,
            trailingTrivia: node.trailingTrivia ?? .zero
        )
        return IntegerLiteralExprSyntax {
            $0.useDigits(digits)
        }
    }
}
```

TenMultiplicationFormatter

```
class TenMultiplicationFormatter: SyntaxRewriter {
    override func visit(_ node: IntegerLiteralExprSyntax) -> ExprSyntax {
        guard let integer = Int(node.digits.text) else {
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TenMultiplicationFormatter

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            trailingTrivia: node.trailingTrivia ?? .zero
        )
        return IntegerLiteralExprSyntax {
            $0.useDigits(digits)
        }
    }
}
```

main.swift

```
// parse Swift source to get SourceFileSyntax
let sourceFile = try SyntaxParser.parse(pathURL)

// visit SourceFileSyntax
var visitor = TenMultiplicationFormatter()
let modifiedSourceFile = TenMultiplicationFormatter().visit(sourceFile)
```

main.swift

```
// parse Swift source to get SourceFileSyntax
let sourceFile = try SyntaxParser.parse(pathURL)

// visit SourceFileSyntax
var visitor = TenMultiplicationFormatter()
let modifiedSourceFile = TenMultiplicationFormatter().visit(sourceFile)
```

Ten multiplication formatter

```
let i: Int = 10 // <- 1
```

Tools make your code much better 😎

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Tools sometimes are better corder than you 😆

Improvements

→ Speeding up SwiftSyntax by using the parser directly

→ Integrating libSyntax into the compiler pipeline

→ Declarative syntax creation using function builders

Summary

Summary

→ Take benefit of statically typed language

Summary

→ Take benefit of statically typed language

→ Useful tools make better apps

Summary

→ Take benefit of statically typed language

→ Useful tools make better apps

→ SwiftSyntax's improving significantly

References

→ https://github.com/apple/swift-syntax

→ https://www.slideshare.net/kitasuke/integrating-libsyntax-into-the-compiler-pipeline

Thank you!